



element

CINCH Systems

RF-CHW-16-433-CLR

FCC 15.231:2021

Periodic Radio

Report: CINC0055, Issue Date: January 18, 2021



NVLAP[®]
TESTING

NVLAP LAB CODE: 200881-0



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CERTIFICATE OF TEST



Last Date of Test: January 13, 2021
CINCH Systems
EUT: RF-CHW-16-433-CLR

Radio Equipment Testing

Standards

Specification	Method
FCC 15.231:2020	
FCC 15.207:2020	ANSI C63.10:2013

Results

Method Clause	Test Description	Applied	Results	Comments
6.2	Powerline Conducted Emissions (Transmitter)	Yes	Pass	
6.5, 6.6	Field Strength of Fundamental	Yes	Pass	
6.5, 6.6	Spurious Radiated Emissions	Yes	Pass	
6.9.2	Occupied Bandwidth	Yes	Pass	
7.4e	Periodic Operation	No	N/A	Not required to test. If applicable, this is addressed by an attestation in the equipment theory of operation.
7.5	Duty Cycle	Yes	N/A	

Deviations From Test Standards

None

Approved By:

Eric Brandon, Department Manager

Product compliance is the responsibility of the client; therefore, the tests and equipment modes of operation represented in this report were agreed upon by the client, prior to testing. The results of this test pertain only to the sample(s) tested. The specific description is noted in each of the individual sections of the test report supporting this certificate of test. This report reflects only those tests from the referenced standards shown in the certificate of test. It does not include inspection or verification of labels, identification, marking or user information. As indicated in the Statement of Work sent with the quotation, Element's standard process is to always use the latest published version of the test methods even when earlier versions are cited in the test specification. Issuance of a purchase order was de facto acceptance of this approach. Otherwise, the client would have advised Element in writing of the specific version of the test methods they wanted applied to the subject testing.

REVISION HISTORY



Revision Number	Description	Date (yyyy-mm-dd)	Page Number
00	None		

ACCREDITATIONS AND AUTHORIZATIONS



United States

FCC - Designated by the FCC as a Telecommunications Certification Body (TCB). Certification chambers, Open Area Test Sites, and conducted measurement facilities are listed with the FCC.

A2LA - Accredited by A2LA to ISO / IEC 17065 as a product certifier. This allows Element to certify transmitters to FCC and IC specifications.

NVLAP - Each laboratory is accredited by NVLAP to ISO 17025

Canada

ISED - Recognized by Innovation, Science and Economic Development Canada as a Certification Body (CB) and as a CAB for the acceptance of test data.

European Union

European Commission – Within Element, we have a EU Notified Body validated for the EMCD and RED Directives.

Australia/New Zealand

ACMA - Recognized by ACMA as a CAB for the acceptance of test data.

Korea

MSIT / RRA - Recognized by KCC's RRA as a CAB for the acceptance of test data.

Japan

VCCI - Associate Member of the VCCI. Conducted and radiated measurement facilities are registered.

Taiwan

BSMI – Recognized by BSMI as a CAB for the acceptance of test data.

NCC - Recognized by NCC as a CAB for the acceptance of test data.

Singapore

IDA – Recognized by IDA as a CAB for the acceptance of test data.

Israel

MOC – Recognized by MOC as a CAB for the acceptance of test data.

Hong Kong

OFCA – Recognized by OFCA as a CAB for the acceptance of test data.

Vietnam

MIC – Recognized by MIC as a CAB for the acceptance of test data.

SCOPE

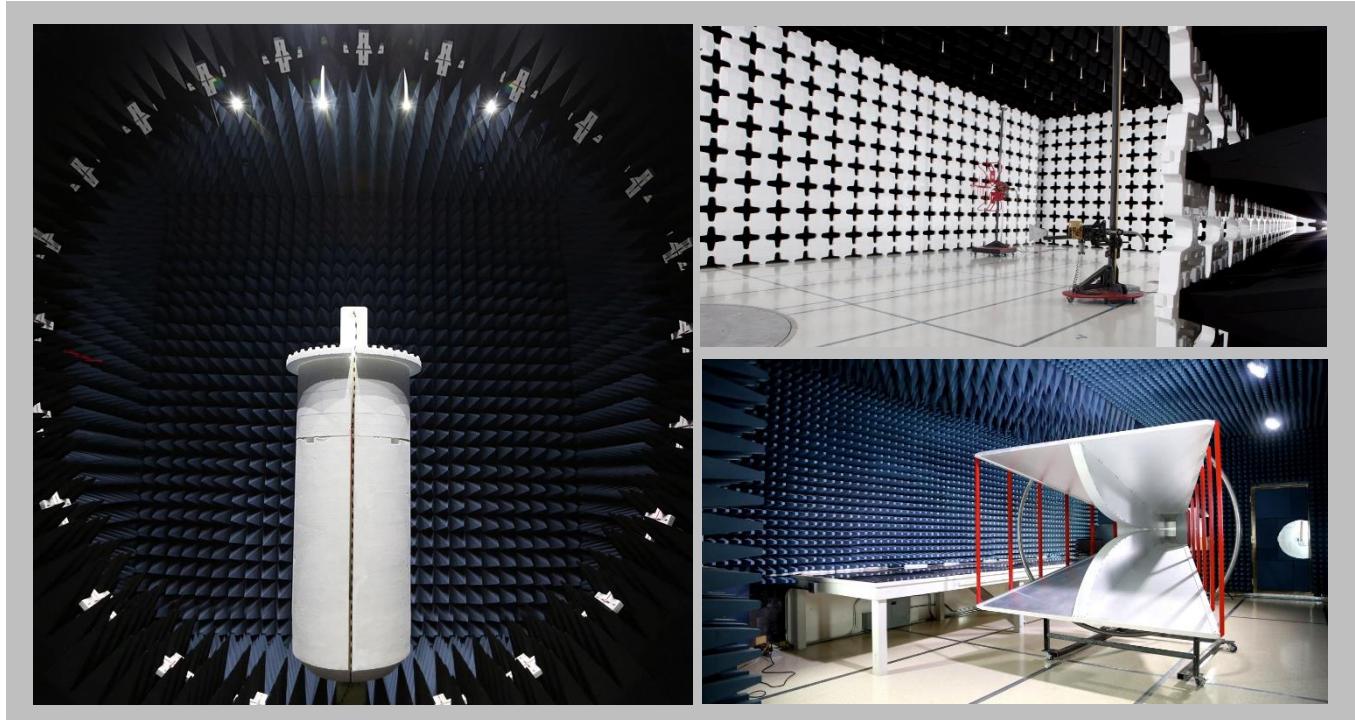
For details on the Scopes of our Accreditations, please visit:

<https://www.nwemc.com/emc-testing-accreditations>

FACILITIES



California Labs OC01-17 41 Tesla Irvine, CA 92618 (949) 861-8918	Minnesota Labs MN01-10 9349 W Broadway Ave. Brooklyn Park, MN 55445 (612) 638-5136	Oregon Labs EV01-12 6775 NE Evergreen Pkwy #400 Hillsboro, OR 97124 (503) 844-4066	Texas Labs TX01-09 3801 E Plano Pkwy Plano, TX 75074 (469) 304-5255	Washington Labs NC01-05 19201 120th Ave NE Bothell, WA 98011 (425) 984-6600
NVLAP				
NVLAP Lab Code: 200676-0	NVLAP Lab Code: 200881-0	NVLAP Lab Code: 200630-0	NVLAP Lab Code: 201049-0	NVLAP Lab Code: 200629-0
Innovation, Science and Economic Development Canada				
2834B-1, 2834B-3	2834E-1, 2834E-3	2834D-1	2834G-1	2834F-1
BSMI				
SL2-IN-E-1154R	SL2-IN-E-1152R	SL2-IN-E-1017	SL2-IN-E-1158R	SL2-IN-E-1153R
VCCI				
A-0029	A-0109	A-0108	A-0201	A-0110
Recognized Phase I CAB for ISED, ACMA, BSMI, IDA, KCC/RRA, MIC, MOC, NCC, OFCA				
US0158	US0175	US0017	US0191	US0157



MEASUREMENT UNCERTAINTY



Measurement Uncertainty

When a measurement is made, the result will be different from the true or theoretically correct value. The difference is the result of tolerances in the measurement system that cannot be completely eliminated. To the extent that technology allows us, it has been our aim to minimize this error. Measurement uncertainty is a statistical expression of measurement error qualified by a probability distribution.

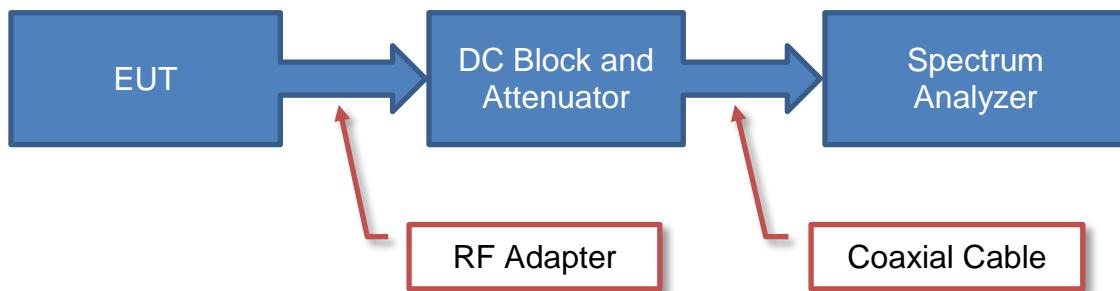
A measurement uncertainty estimation has been performed for each test per our internal quality document QM205.4.6. The estimation is used to compare the measured result with its "true" or theoretically correct value. The expanded measurement uncertainty (K=2) can be found included as part of the applicable test description page. Our measurement data meets or exceeds the measurement uncertainty requirements of the applicable specification; therefore, the test data can be compared directly to the specification limit to determine compliance. The calculations for estimating measurement uncertainty are based upon ETSI TR 100 028 (or CISPR 16-4-2 as applicable), and are available upon request.

The following table represents the Measurement Uncertainty (MU) budgets for each of the tests that may be contained in this report.

Test	+ MU	- MU
Frequency Accuracy	0.0007%	-0.0007%
Amplitude Accuracy (dB)	1.2 dB	-1.2 dB
Conducted Power (dB)	1.2 dB	-1.2 dB
Radiated Power via Substitution (dB)	0.7 dB	-0.7 dB
Temperature (degrees C)	0.7°C	-0.7°C
Humidity (% RH)	2.5% RH	-2.5% RH
Voltage (AC)	1.0%	-1.0%
Voltage (DC)	0.7%	-0.7%
Field Strength (dB)	5.2 dB	-5.2 dB
AC Powerline Conducted Emissions (dB)	2.6 dB	-2.6 dB

Test Setup Block Diagrams

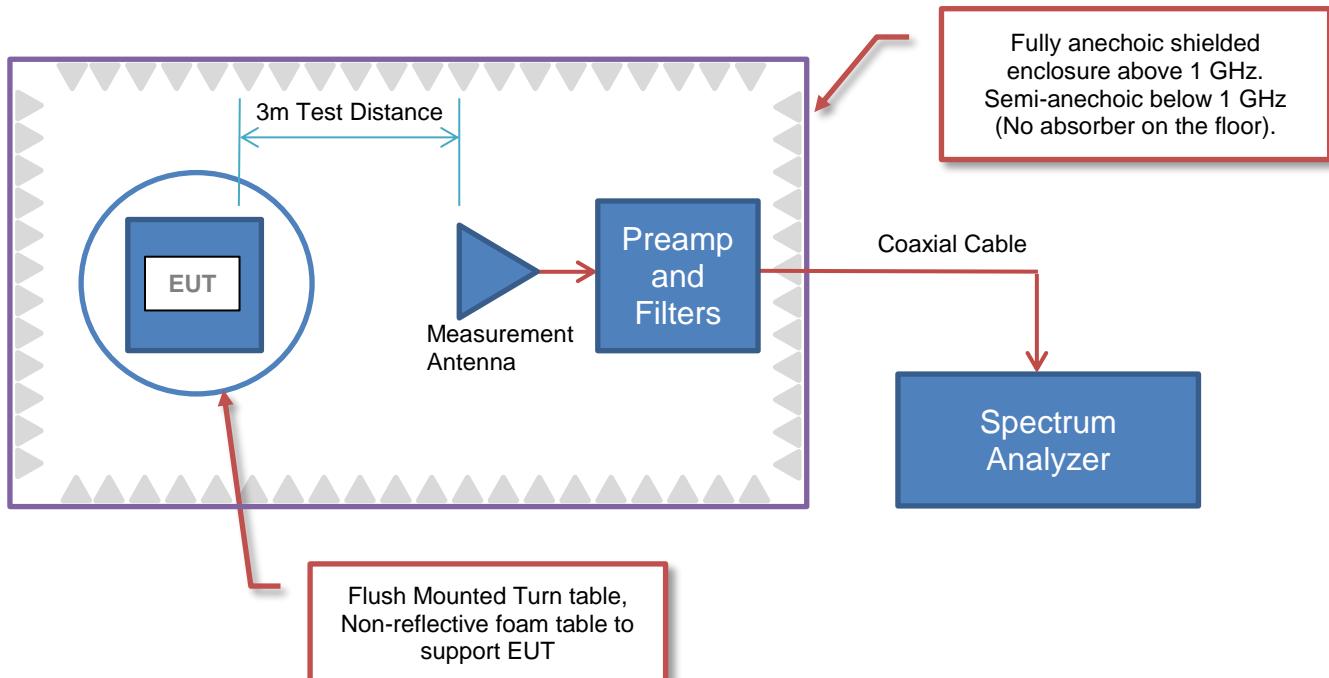
Antenna Port Conducted Measurements



Near Field Test Fixture Measurements



Spurious Radiated Emissions



PRODUCT DESCRIPTION



Client and Equipment Under Test (EUT) Information

Company Name:	CINCH Systems
Address:	12075 43rd Street NE Suite 300
City, State, Zip:	St. Michael, MN 55376
Test Requested By:	Jibril Aga
EUT:	RF-CHW-16-433-CLR
First Date of Test:	September 1, 2020
Last Date of Test:	January 13, 2021
Receipt Date of Samples:	September 1, 2020
Equipment Design Stage:	Production
Equipment Condition:	No Damage
Purchase Authorization:	Verified

Information Provided by the Party Requesting the Test

Functional Description of the EUT:
Sensor with a periodic radio
Testing Objective:
To demonstrate compliance to FCC 15.231 specifications.

CONFIGURATIONS

Configuration CINC0055- 4

EUT				
Description	Manufacturer	Model/Part Number	Serial Number	
Hardwire Module	CINCH Systems	RF-CHW-16-433-CLR	CM12C	

Peripherals in test setup boundary				
Description	Manufacturer	Model/Part Number	Serial Number	
AC/DC Adapter (Hardwire Module)	Unknown	CSE1601-D	None	

Cables					
Cable Type	Shield	Length (m)	Ferrite	Connection 1	Connection 2
DC Cable (Hardwire Module)	No	1.5m	No	Hardwire Module	AC/DC Adapter (Hardwire Module)

Configuration CINC0055- 5

EUT				
Description	Manufacturer	Model/Part Number	Serial Number	
Hardwire Module	CINCH Systems	RF-CHW-16-433-CLR	CP12B	

Peripherals in test setup boundary				
Description	Manufacturer	Model/Part Number	Serial Number	
AC/DC Adapter (Hardwire Module)	Unknown	CSE1601-D	None	

Cables					
Cable Type	Shield	Length (m)	Ferrite	Connection 1	Connection 2
DC Cable (Hardwire Module)	No	1.5m	No	Hardwire Module	AC/DC Adapter (Hardwire Module)

CONFIGURATIONS



Configuration CINC0061- 1

EUT			
Description	Manufacturer	Model/Part Number	Serial Number
Hardwire Module	CINCH Systems	RF-CHW-15-433-CLR	CC12A

Peripherals in test setup boundary			
Description	Manufacturer	Model/Part Number	Serial Number
AC/DC Adapter (Hardwire Module)	Unknown	CSE1601-D	None

Cables					
Cable Type	Shield	Length (m)	Ferrite	Connection 1	Connection 2
DC Cable (Hardwire Module)	No	1.5 m	No	AC/DC Adapter (Hardwire Module)	Hardwire Module
Hardwire (x8)	No	0.9 m	No	Hardwire Module	Hardwire Module

MODIFICATIONS



Equipment Modifications

Item	Date	Test	Modification	Note	Disposition of EUT
1	2020-09-01	Duty Cycle	Tested as delivered to Test Station.	No EMI suppression devices were added or modified during this test.	EUT remained at Element following the test.
2	2020-09-01	Occupied Bandwidth	Tested as delivered to Test Station.	No EMI suppression devices were added or modified during this test.	EUT remained at Element following the test.
3	2020-09-21	Powerline Conducted Emissions (Transmitter)	Tested as delivered to Test Station.	No EMI suppression devices were added or modified during this test.	EUT remained at Element following the test.
4	2021-01-13	Field Strength of Fundamental	Tested as delivered to Test Station.	No EMI suppression devices were added or modified during this test.	EUT remained at Element following the test.
5	2021-01-13	Spurious Radiated Emissions	Tested as delivered to Test Station.	No EMI suppression devices were added or modified during this test.	Scheduled testing was completed.

POWER SETTINGS



The EUT was tested using the power settings provided by the manufacturer:

SETTINGS FOR ALL TESTS IN THIS REPORT

Power Setting	Test
0x50	Field Strength of Fundamental
	Spurious Radiated Emissions
0x28	Occupied Bandwidth
	Duty Cycle

POWERLINE CONDUCTED EMISSIONS (TRANSMITTER)



TEST DESCRIPTION

Using the mode of operation and configuration noted within this report, conducted emissions tests were performed. The frequency range investigated (scanned), is also noted in this report. Conducted power line measurements are made, unless otherwise specified, over the frequency range from 150 kHz to 30 MHz to determine the line-to-ground radio-noise voltage that is conducted from the EUT power-input terminals that are directly (or indirectly via separate transformer or power supplies) connected to a public power network. Per the standard, an insulating material was also added to ground plane between the EUT's power and remote I/O cables. Equipment is tested with power cords that are normally used or that have electrical or shielding characteristics that are the same as those cords normally used. Typically those measurements are made using a LISN (Line Impedance Stabilization Network), the 50ohm measuring port is terminated by a 50ohm EMI meter or a 50ohm resistive load. All 50ohm measuring ports of the LISN are terminated by 50ohm. The test data represents the configuration / operating mode/ model that produced the highest emission levels as compared to the specification limit.

TEST EQUIPMENT

Description	Manufacturer	Model	ID	Last Cal.	Cal. Due
Receiver	Rohde & Schwarz	ESR7	ARI	2020-07-09	2021-07-09
LISN	Solar Electronics	9252-50-R-24-BNC	LIY	2020-03-15	2021-03-15
Cable - Conducted Cable Assembly	Northwest EMC	MNC, HGN, TYK	MNCA	2020-03-11	2021-03-11

MEASUREMENT UNCERTAINTY

Description		
Expanded k=2	2.6 dB	-2.6 dB

CONFIGURATIONS INVESTIGATED

CINC0055-4

MODES INVESTIGATED

Transmitting 433.95 MHz unmodulated

POWERLINE CONDUCTED EMISSIONS (TRANSMITTER)



EUT:	RF-CHW-15-433-CLR	Work Order:	CINC0055
Serial Number:	CM12C	Date:	2020-09-21
Customer:	CINCH Systems	Temperature:	21.9°C
Attendees:	None	Relative Humidity:	48.4%
Customer Project:	None	Bar. Pressure:	1021 mb
Tested By:	Chris Patterson	Job Site:	MN03
Power:	110VAC/60Hz	Configuration:	CINC0055-4

TEST SPECIFICATIONS

Specification:	Method:
FCC 15.207:2020	ANSI C63.10:2013

TEST PARAMETERS

Run #:	1	Line:	Neutral	Add. Ext. Attenuation (dB):	0
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COMMENTS

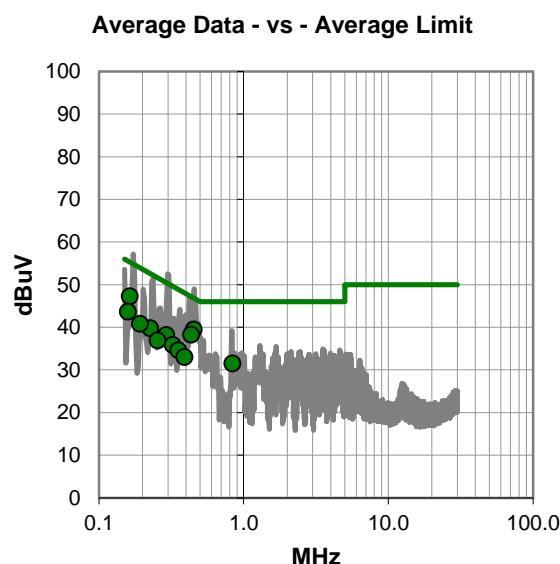
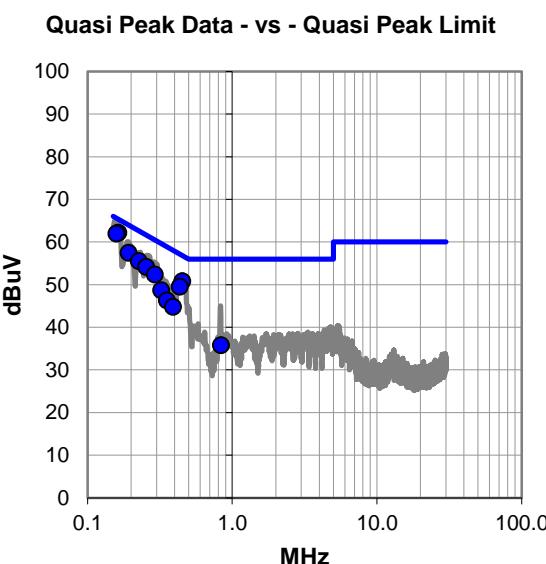
None

EUT OPERATING MODES

Transmitting 433.95 MHz unmodulated

DEVIATIONS FROM TEST STANDARD

None



POWERLINE CONDUCTED EMISSIONS (TRANSMITTER)



RESULTS - Run #1

Quasi Peak Data - vs - Quasi Peak Limit

Freq (MHz)	Amp. (dBuV)	Factor (dB)	Adjusted (dBuV)	Spec. Limit (dBuV)	Margin (dB)
0.163	41.3	20.9	62.2	65.3	-3.1
0.158	41.1	20.9	62.0	65.6	-3.6
0.451	30.3	20.5	50.8	56.9	-6.1
0.192	36.8	20.7	57.5	63.9	-6.4
0.226	34.8	20.7	55.5	62.6	-7.1
0.254	33.5	20.7	54.2	61.6	-7.4
0.432	29.0	20.5	49.5	57.2	-7.7
0.291	31.9	20.5	52.4	60.5	-8.1
0.322	28.2	20.5	48.7	59.7	-11.0
0.353	25.8	20.5	46.3	58.9	-12.6
0.389	24.3	20.5	44.8	58.1	-13.3
0.834	15.3	20.5	35.8	56.0	-20.2

Average Data - vs - Average Limit

Freq (MHz)	Amp. (dBuV)	Factor (dB)	Adjusted (dBuV)	Spec. Limit (dBuV)	Margin (dB)
0.451	19.0	20.5	39.5	46.9	-7.4
0.163	26.4	20.9	47.3	55.3	-8.0
0.432	17.8	20.5	38.3	47.2	-8.9
0.158	22.8	20.9	43.7	55.6	-11.9
0.291	17.7	20.5	38.2	50.5	-12.3
0.226	19.1	20.7	39.8	52.6	-12.8
0.192	20.1	20.7	40.8	53.9	-13.1
0.322	15.4	20.5	35.9	49.7	-13.8
0.353	14.1	20.5	34.6	48.9	-14.3
0.834	11.0	20.5	31.5	46.0	-14.5
0.254	16.2	20.7	36.9	51.6	-14.7
0.389	12.5	20.5	33.0	48.1	-15.1

CONCLUSION

Pass

Tested By

POWERLINE CONDUCTED EMISSIONS (TRANSMITTER)



EUT:	RF-CHW-15-433-CLR	Work Order:	CINC0055
Serial Number:	CM12C	Date:	2020-09-21
Customer:	CINCH Systems	Temperature:	21.9°C
Attendees:	None	Relative Humidity:	48.4%
Customer Project:	None	Bar. Pressure:	1021 mb
Tested By:	Chris Patterson	Job Site:	MN03
Power:	110VAC/60Hz	Configuration:	CINC0055-4

TEST SPECIFICATIONS

Specification:	Method:
FCC 15.207:2020	ANSI C63.10:2013

TEST PARAMETERS

Run #:	2	Line:	High Line	Add. Ext. Attenuation (dB):	0
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COMMENTS

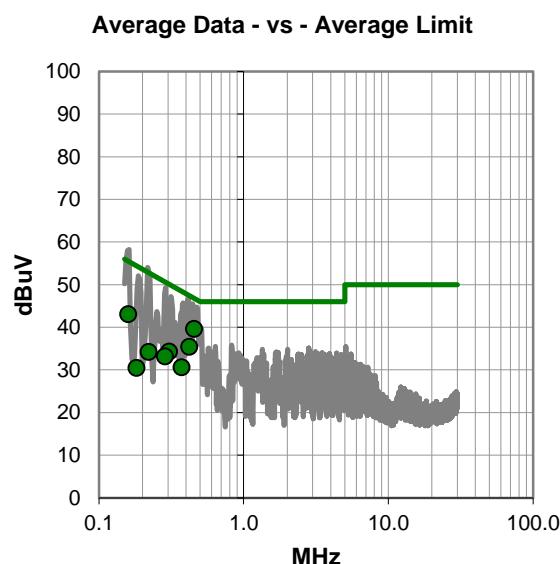
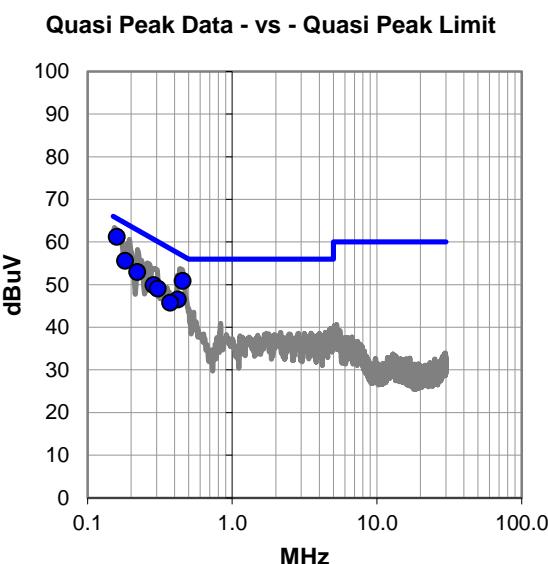
None

EUT OPERATING MODES

Transmitting 433.95 MHz unmodulated

DEVIATIONS FROM TEST STANDARD

None



POWERLINE CONDUCTED EMISSIONS (TRANSMITTER)



RESULTS - Run #2

Quasi Peak Data - vs - Quasi Peak Limit

Freq (MHz)	Amp. (dBuV)	Factor (dB)	Adjusted (dBuV)	Spec. Limit (dBuV)	Margin (dB)
0.159	40.3	20.9	61.2	65.5	-4.3
0.454	30.4	20.5	50.9	56.8	-5.9
0.182	34.8	20.8	55.6	64.4	-8.8
0.220	32.3	20.7	53.0	62.8	-9.8
0.285	29.4	20.5	49.9	60.7	-10.8
0.304	28.6	20.5	49.1	60.1	-11.0
0.420	26.0	20.5	46.5	57.5	-11.0
0.372	25.3	20.5	45.8	58.5	-12.7

Average Data - vs - Average Limit

Freq (MHz)	Amp. (dBuV)	Factor (dB)	Adjusted (dBuV)	Spec. Limit (dBuV)	Margin (dB)
0.454	19.1	20.5	39.6	46.8	-7.2
0.420	14.9	20.5	35.4	47.5	-12.1
0.159	22.2	20.9	43.1	55.5	-12.4
0.304	13.8	20.5	34.3	50.1	-15.8
0.285	12.7	20.5	33.2	50.7	-17.5
0.372	10.1	20.5	30.6	48.5	-17.9
0.220	13.5	20.7	34.2	52.8	-18.6
0.182	9.7	20.8	30.5	54.4	-23.9

CONCLUSION

Pass

Tested By

FIELD STRENGTH OF FUNDAMENTAL



PSA-ESCI 2020.06.24.2

Testing was performed using the mode(s) of operation and configuration(s) noted within the report. The individuals and/or the organization requesting the test provided the modes, configurations and settings used to complete the evaluation. The actual test parameters are specified in the test data, this includes items such as investigated frequency range (scanned) and test levels. The testing methods and performance specifications, as well as the test site used for the evaluation are indicated in the test data. The test data represents the configuration / operating mode/ model that produced the highest emission levels as compared to the specification limit.

MODES OF OPERATION

Tx at 433.95 MHz 100% duty cycle unmodulated.

POWER SETTINGS INVESTIGATED

110VAC/60Hz

CONFIGURATIONS INVESTIGATED

CINC0061 - 1

FREQUENCY RANGE INVESTIGATED

Start Frequency	433 MHz	Stop Frequency	435 MHz
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SAMPLE CALCULATIONS

Radiated Emissions: Field Strength = Measured Level + Antenna Factor + Cable Factor - Amplifier Gain + Distance Adjustment Factor + External Attenuation

TEST EQUIPMENT

Description	Manufacturer	Model	ID	Last Cal.	Interval
Cable	ESM Cable Corp.	Bilog Cables	MNH	2020-10-06	12 mo
Antenna - Biconilog	ETS Lindgren	3142D	AXO	2019-09-03	24 mo
Analyzer - Spectrum Analyzer	Keysight	N9010A (EXA)	AFQ	2020-12-27	12 mo

MEASUREMENT BANDWIDTHS

Frequency Range (MHz)	Peak Data (kHz)	Quasi-Peak Data (kHz)	Average Data (kHz)
0.01 - 0.15	1.0	0.2	0.2
0.15 - 30.0	10.0	9.0	9.0
30.0 - 1000	100.0	120.0	120.0
Above 1000	1000.0	N/A	1000.0

TEST DESCRIPTION

The antennas to be used with the EUT were tested. The EUT was configured for continuous un-modulated CW operation at its single transmit frequency. The field strength of the transmit frequency was maximized by rotating the EUT, adjusting the measurement antenna height and polarization, and manipulating the EUT in 3 orthogonal planes (per ANSI C63.10:2013).

Peak measurements were made with a resolution bandwidth of 100 kHz and a video bandwidth of 300 kHz for measurements at or below 1 GHz. A duty cycle correction factor was added to the peak readings to mathematically derive the average levels. The supporting screen captures and duty cycle calculation is contained in the "Duty Cycle" module in this report.

FIELD STRENGTH OF FUNDAMENTAL

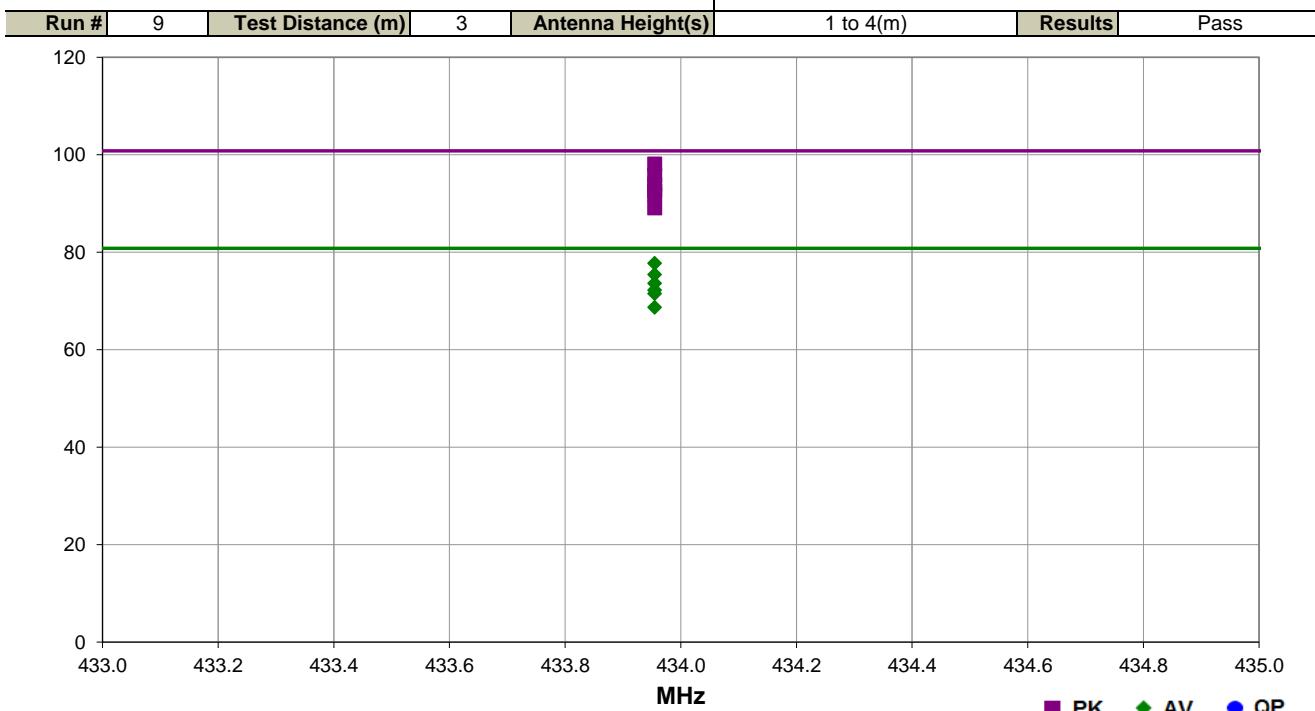


EmIR5 2020.12.09.0

PSA-ESCI 2020.06.24.2

Work Order:	CINC0061	Date:	2021-01-13	
Project:	None	Temperature:	22.5 °C	
Job Site:	MN05	Humidity:	27.5% RH	
Serial Number:	CC12A	Barometric Pres.:	1007 mbar	
EUT:	RF-CHW-16-433-CLR	Tested by:	Kyle McMullan	
Configuration:	1			
Customer:	CINCH Systems			
Attendees:	Jibril Aga			
EUT Power:	110VAC/60Hz			
Operating Mode:	Tx at 433.95 MHz 100% duty cycle unmodulated.			
Deviations:	None			
Comments:	Power setting 0x50			

Test Specifications	Test Method
FCC 15.231:2021	ANSI C63.10:2013



Freq (MHz)	Amplitude (dBuV)	Factor (dB)	Antenna Height (meters)	Azimuth (degrees)	Duty Cycle Correction Factor (dB)	External Attenuation (dB)	Polarity/Transducer Type	Detector	Distance Adjustment (dB)	Adjusted (dBuV/m)	Spec. Limit (dBuV/m)	Compared to Spec. (dB)	Comments
433.955	63.4	24.7	1.1	351.0		10.0	Vert	PK	0.0	98.1	100.8	-2.7	EUT Vert
433.955	63.4	24.7	1.1	351.0	-20.4	10.0	Vert	AV	0.0	77.7	80.8	-3.1	EUT Vert
433.955	61.1	24.7	1.0	333.0		10.0	Horz	PK	0.0	95.8	100.8	-5.0	EUT Horz
433.955	61.1	24.7	1.0	333.0	-20.4	10.0	Horz	AV	0.0	75.4	80.8	-5.4	EUT Horz
433.955	59.3	24.7	1.0	211.9		10.0	Horz	PK	0.0	94.0	100.8	-6.8	EUT On Side
433.955	59.3	24.7	1.0	211.9	-20.4	10.0	Horz	AV	0.0	73.6	80.8	-7.2	EUT On Side
433.955	57.9	24.7	1.1	121.9		10.0	Vert	PK	0.0	92.6	100.8	-8.2	EUT On Side
433.955	57.9	24.7	1.1	121.9	-20.4	10.0	Vert	AV	0.0	72.2	80.8	-8.6	EUT On Side
433.955	57.2	24.7	1.0	198.0		10.0	Horz	PK	0.0	91.9	100.8	-8.9	EUT Vert
433.955	57.2	24.7	1.0	198.0	-20.4	10.0	Horz	AV	0.0	71.5	80.8	-9.3	EUT Vert
433.955	54.4	24.7	2.3	181.9		10.0	Vert	PK	0.0	89.1	100.8	-11.7	EUT Horz
433.955	54.4	24.7	2.3	181.9	-20.4	10.0	Vert	AV	0.0	68.7	80.8	-12.1	EUT Horz

SPURIOUS RADIATED EMISSIONS



PSA-ESCI 2020.06.24.2

Testing was performed using the mode(s) of operation and configuration(s) noted within the report. The individuals and/or the organization requesting the test provided the modes, configurations and settings used to complete the evaluation. The actual test parameters are specified in the test data, this includes items such as investigated frequency range (scanned) and test levels. The testing methods and performance specifications, as well as the test site used for the evaluation are indicated in the test data. The test data represents the configuration / operating mode/ model that produced the highest emission levels as compared to the specification limit.

MODES OF OPERATION

Tx at 433.95 MHz 100% duty cycle unmodulated.

POWER SETTINGS INVESTIGATED

110VAC/60Hz

CONFIGURATIONS INVESTIGATED

CINC0061 - 1

FREQUENCY RANGE INVESTIGATED

Start Frequency	30 MHz	Stop Frequency	1000 MHz
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SAMPLE CALCULATIONS

Radiated Emissions: Field Strength = Measured Level + Antenna Factor + Cable Factor - Amplifier Gain + Distance Adjustment Factor + External Attenuation

TEST EQUIPMENT

Description	Manufacturer	Model	ID	Last Cal.	Interval
Filter - High Pass	Micro-Tronics	HPM50108	LFM	2020-09-14	12 mo
Attenuator	Fairview Microwave	SA18E-10	TYA	2020-09-14	12 mo
Amplifier - Pre-Amplifier	Miteq	AM-1616-1000	AVO	2020-10-06	12 mo
Cable	ESM Cable Corp.	Bilog Cables	MNH	2020-10-06	12 mo
Antenna - Biconilog	ETS Lindgren	3142D	AXO	2019-09-03	24 mo
Analyzer - Spectrum Analyzer	Keysight	N9010A (EXA)	AFQ	2020-12-27	12 mo

MEASUREMENT BANDWIDTHS

Frequency Range (MHz)	Peak Data (kHz)	Quasi-Peak Data (kHz)	Average Data (kHz)
0.01 - 0.15	1.0	0.2	0.2
0.15 - 30.0	10.0	9.0	9.0
30.0 - 1000	100.0	120.0	120.0
Above 1000	1000.0	N/A	1000.0

TEST DESCRIPTION

The highest gain antenna of each type to be used with the EUT was tested. The EUT was configured for the required transmit frequency in each operational band and the modes as showed in the data sheets.

For each configuration, the spectrum was scanned throughout the specified range as part of the exploratory investigation of the emissions. These “pre-scans” are not included in the report. Final measurements on individual emissions were then made and included in this test report.

The individual emissions from the EUT were maximized by rotating the EUT on a turntable, adjusting the position of the EUT and EUT antenna in three orthogonal axis, and adjusting the measurement antenna height and polarization (per ANSI C63.10). A preamp and high pass filter (and notch filter) were used for this test in order to provide sufficient measurement sensitivity.

Measurements were made with the required detectors and annotated on the data for each individual point using the following annotation:

QP = Quasi-Peak Detector

PK = Peak Detector

AV = Calculated Average based on Peak and Duty Cycle Correction Factor

Peak measurements were made with a resolution bandwidth of 100 kHz and a video bandwidth of 300 kHz for measurements at or below 1 GHz. Above 1 GHz, a resolution bandwidth of 1 MHz and a video bandwidth of 3 MHz was used.

A duty cycle correction factor was added to the peak readings to mathematically derive the average levels. The supporting screen captures and duty cycle calculation is contained in the “Duty Cycle” module in this report.

SPURIOUS RADIATED EMISSIONS

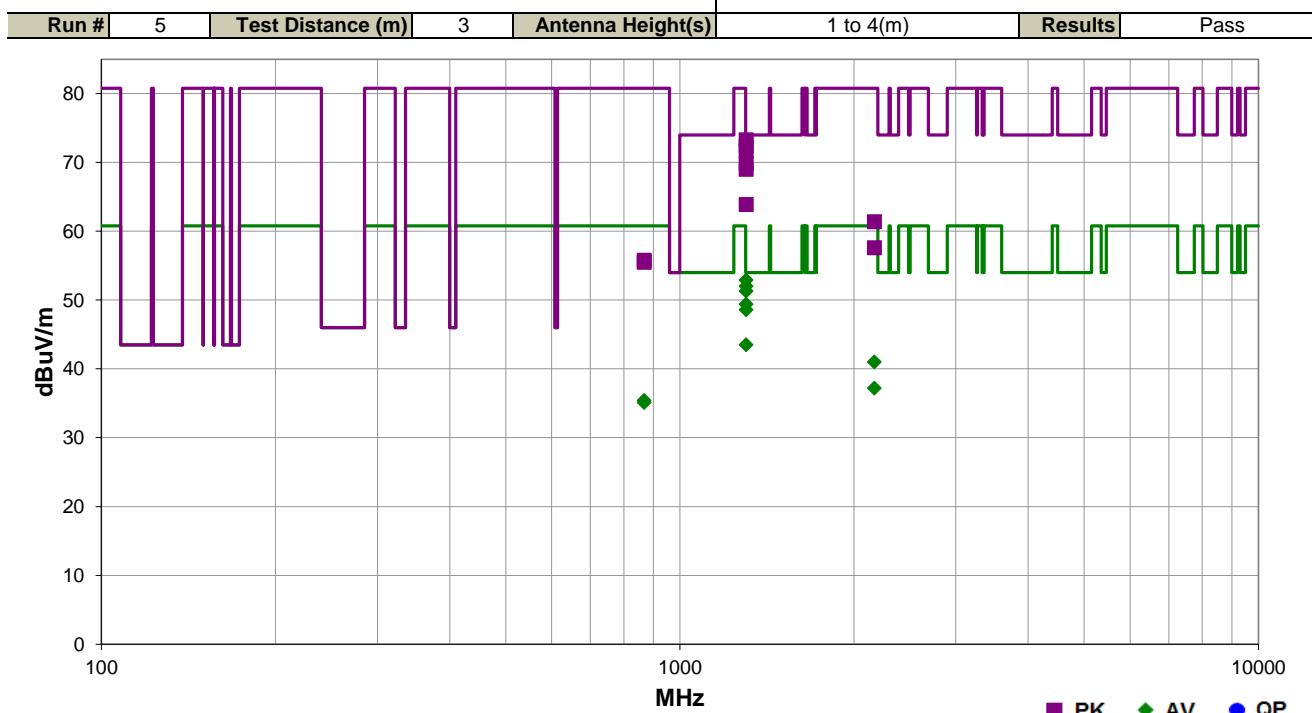


EmIR5 2020.12.09.0

PSA-ESCI 2020.06.24.2

Work Order:	CINC0061	Date:	2021-01-13	
Project:	None	Temperature:	22.5 °C	
Job Site:	MN05	Humidity:	27.5% RH	
Serial Number:	CC12A	Barometric Pres.:	1007 mbar	Tested by: Kyle McMullan
EUT:	RF-CHW-16-433-CLR			
Configuration:	1			
Customer:	CINCH Systems			
Attendees:	Jibril Aga			
EUT Power:	110VAC/60Hz			
Operating Mode:	Tx at 433.95 MHz 100% duty cycle unmodulated.			
Deviations:	None			
Comments:	Power setting 0x50			

Test Specifications	Test Method
FCC 15.231:2021	ANSI C63.10:2013



Freq (MHz)	Amplitude (dBuV)	Factor (dB)	Antenna Height (meters)	Azimuth (degrees)	Duty Cycle Correction Factor (dB)	External Attenuation (dB)	Polarity/Transducer Type	Detector	Distance Adjustment (dB)	Adjusted (dBuV/m)	Spec. Limit (dBuV/m)	Compared to Spec. (dB)	Comments
1301.833	71.0	-7.7	3.7	353.0		10.0	Vert	PK	0.0	73.3	74.0	-0.7	EUT Vertical
1301.833	71.0	-7.7	3.7	353.0	-20.4	10.0	Vert	AV	0.0	52.9	54.0	-1.1	EUT Vertical
1301.842	70.1	-7.7	1.2	312.9		10.0	Horz	PK	0.0	72.4	74.0	-1.6	EUT On Side
1301.842	70.1	-7.7	1.2	312.9	-20.4	10.0	Horz	AV	0.0	52.0	54.0	-2.0	EUT On Side
1301.900	69.4	-7.7	1.3	4.0		10.0	Vert	PK	0.0	71.7	74.0	-2.3	EUT On Side
1301.900	69.4	-7.7	1.3	4.0	-20.4	10.0	Vert	AV	0.0	51.3	54.0	-2.7	EUT On Side
1301.842	67.5	-7.7	1.2	311.9		10.0	Horz	PK	0.0	69.8	74.0	-4.2	EUT Horz
1301.842	67.5	-7.7	1.2	311.9	-20.4	10.0	Horz	AV	0.0	49.4	54.0	-4.6	EUT Horz
1301.867	66.7	-7.7	3.5	16.0		10.0	Vert	PK	0.0	69.0	74.0	-5.0	EUT Horz
1301.867	66.7	-7.7	3.5	16.0	-20.4	10.0	Vert	AV	0.0	48.6	54.0	-5.4	EUT Horz
1301.867	61.6	-7.7	1.2	296.0		10.0	Horz	PK	0.0	63.9	74.0	-10.1	EUT Vertical
1301.867	61.6	-7.7	1.2	296.0	-20.4	10.0	Horz	AV	0.0	43.5	54.0	-10.5	EUT Vertical
2169.717	54.4	-3.0	1.3	285.0		10.0	Vert	PK	0.0	61.4	80.8	-19.4	EUT Vert

Freq (MHz)	Amplitude (dBuV)	Factor (dB)	Antenna Height (meters)	Azimuth (degrees)	Duty Cycle Correction Factor (dB)	External Attenuation (dB)	Polarity/Transducer Type	Detector	Distance Adjustment (dB)	Adjusted (dBuV/m)	Spec. Limit (dBuV/m)	Compared to Spec. (dB)	Comments
2169.717	54.4	-3.0	1.3	285.0	-20.4	10.0	Vert	AV	0.0	41.0	60.8	-19.8	EUT Vert
2169.675	50.6	-3.0	1.1	113.0		10.0	Horz	PK	0.0	57.6	80.8	-23.2	EUT On Side
2169.675	50.6	-3.0	1.1	113.0	-20.4	10.0	Horz	AV	0.0	37.2	60.8	-23.6	EUT On Side
867.910	31.9	13.9	3.1	330.9		10.0	Vert	PK	0.0	55.8	80.8	-25.0	EUT Vert
867.905	31.6	13.9	1.0	286.0		10.0	Horz	PK	0.0	55.5	80.8	-25.3	EUT On Side
867.910	31.9	13.9	3.1	330.9	-20.4	10.0	Vert	AV	0.0	35.4	60.8	-25.4	EUT Vert
867.905	31.6	13.9	1.0	286.0	-20.4	10.0	Horz	AV	0.0	35.1	60.8	-25.7	EUT On Side

OCCUPIED BANDWIDTH



XMit 2020.03.25.0

Testing was performed using the mode(s) of operation and configuration(s) noted within the report. The individuals and/or the organization requesting the test provided the modes, configurations and settings used to complete the evaluation. The actual test parameters are specified in the test data, this includes items such as investigated frequency range (scanned) and test levels. The testing methods and performance specifications, as well as the test site used for the evaluation are indicated in the test data.

TEST EQUIPMENT

Description	Manufacturer	Model	ID	Last Cal.	Cal. Due
Cable	Element	Biconilog Cable	MNX	18-Feb-20	18-Feb-21
Antenna - Biconilog	Ametek	CBL 6141B	AYS	19-Mar-19	19-Mar-21
Analyzer - Spectrum Analyzer	Keysight	N9010A	AFM	14-Apr-20	14-Apr-21

TEST DESCRIPTION

The EUT was transmitting at its maximum data rate.

The 20 dB occupied bandwidth is required to be no wider than 0.25% of the center frequency for devices operating above 70 MHz and below 900 MHz.

OCCUPIED BANDWIDTH



XMI 2020.03.25.0

EUT:	RF-CHW-16-433-CLR		Work Order:	CINC0055		
Serial Number:	CP12B		Date:	1-Sep-20		
Customer:	CINCH Systems		Temperature:	22.1 °C		
Attendees:	Jibril Aga		Humidity:	50% RH		
Project:	None		Barometric Pres.:	1011 mbar		
Tested by:	Dustin Sparks	Power:	110VAC/60Hz		Job Site:	MN09
TEST SPECIFICATIONS			Test Method			
FCC 15.231:2020			ANSI C63.10:2013			
COMMENTS						
None						
DEVIATIONS FROM TEST STANDARD						
None						
Configuration #	5	Signature	Dustin Sparks	Value (kHz)	Limit (± kHz)	
				30.58	1085	
					Pass	

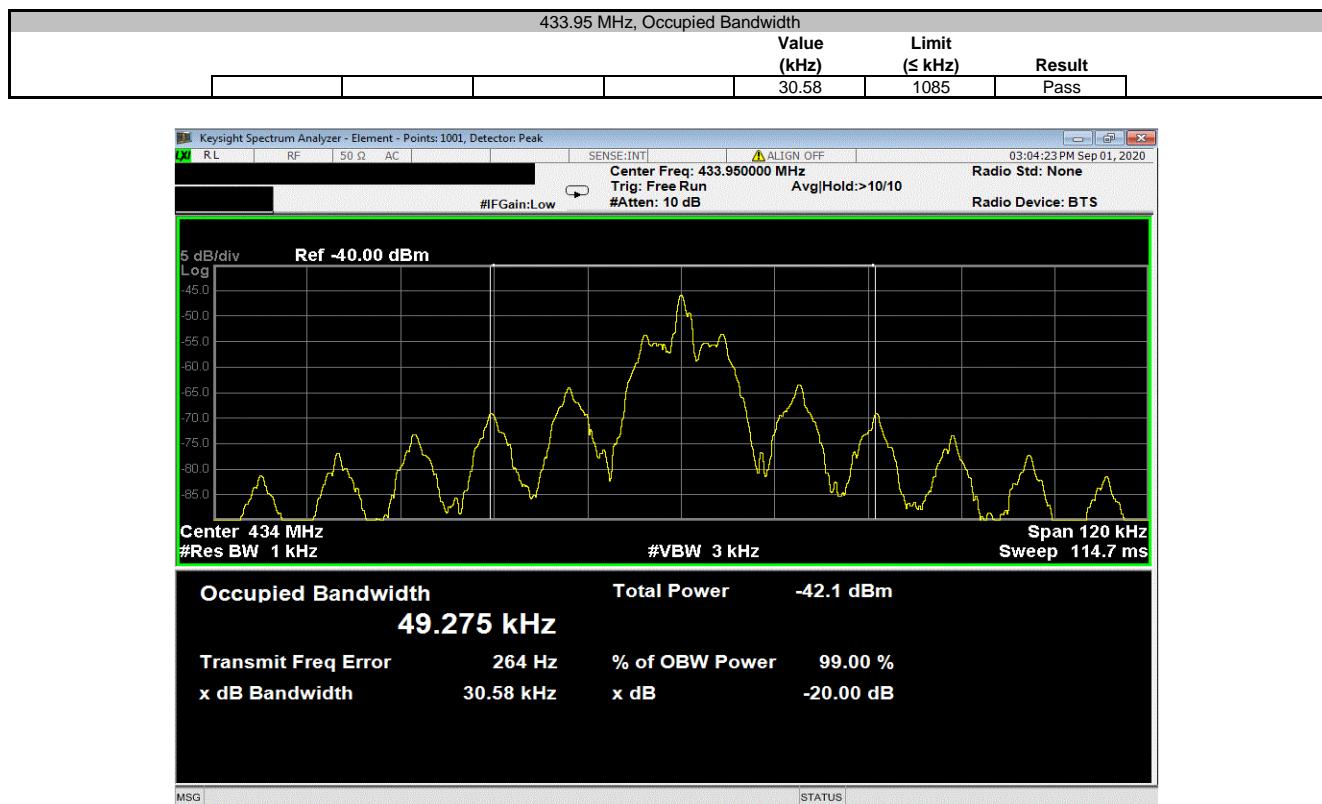
433.95 MHz

Occupied Bandwidth

OCCUPIED BANDWIDTH



XMit 2020.03.25.0



DUTY CYCLE



XMit 2020.03.25.0

Testing was performed using the mode(s) of operation and configuration(s) noted within the report. The individuals and/or the organization requesting the test provided the modes, configurations and settings used to complete the evaluation. The actual test parameters are specified in the test data, this includes items such as investigated frequency range (scanned) and test levels. The testing methods and performance specifications, as well as the test site used for the evaluation are indicated in the test data.

TEST EQUIPMENT

Description	Manufacturer	Model	ID	Last Cal.	Cal. Due
Cable	Element	Biconilog Cable	MNX	18-Feb-20	18-Feb-21
Antenna - Biconilog	Ametek	CBL 6141B	AYS	19-Mar-19	19-Mar-21
Analyzer - Spectrum Analyzer	Keysight	N9010A	AFM	14-Apr-20	14-Apr-21

TEST DESCRIPTION

For software controlled or pre-programmed devices, the manufacturer shall declare the duty cycle class or classes for the equipment under test. For manually operated or event dependant devices, with or without software controlled functions, the manufacturer shall declare whether the device once triggered, follows a pre-programmed cycle, or whether the transmission is constant until the trigger is released or manually reset. The manufacturer shall also give a description of the application for the device and include a typical usage pattern. The typical usage pattern as declared by the manufacturer shall be used to determine the duty cycle and hence the duty class.

Where an acknowledgement is required, the additional transmitter on-time shall be included and declared by the manufacturer.

To derive average emission measurements, a duty cycle correction factor was utilized:

Duty Cycle = On time/100 milliseconds (or the period, whichever is less)

Where "On time" = $N1L1 + N2L2 + \dots$

Where $N1$ is the number of type 1 pulses, $L1$ is length of type 1 pulses, $N2$ is the number of type 2 pulses, $L2$ is the length of type 2 pulses, etc.

Therefore, Duty Cycle = $(N1L1 + N2L2 + \dots)/100\text{mS}$ or T , whichever is less. (Where T is the period of the pulse train.)

The measured values for the EUT's pulse train are as follows:

Period = **100** mSec

Pulsewidth of Type 1 Pulse = **0.6528** mSec

Pulsewidth of Type 2 Pulse = **0.09387** mSec

Pulsewidth of Type 3 Pulse = **0.1856** mSec

Number of Type 1 Pulses = **1**

Number of Type 2 Pulses = **55**

Number of Type 3 Pulses = **20**

Duty Cycle Correction Factor = $20 \log [((0.6528) + (55)(0.09387) + (20)(0.1856))/100] = -20.4 \text{ dB}$

The duty cycle correction factor of **-20.4 dB** was added to the peak readings to mathematically derive the average levels. Peak measurements were made with a resolution bandwidth of 100kHz and a video bandwidth of 300kHz.

DUTY CYCLE



XMI 2020.03.25.0

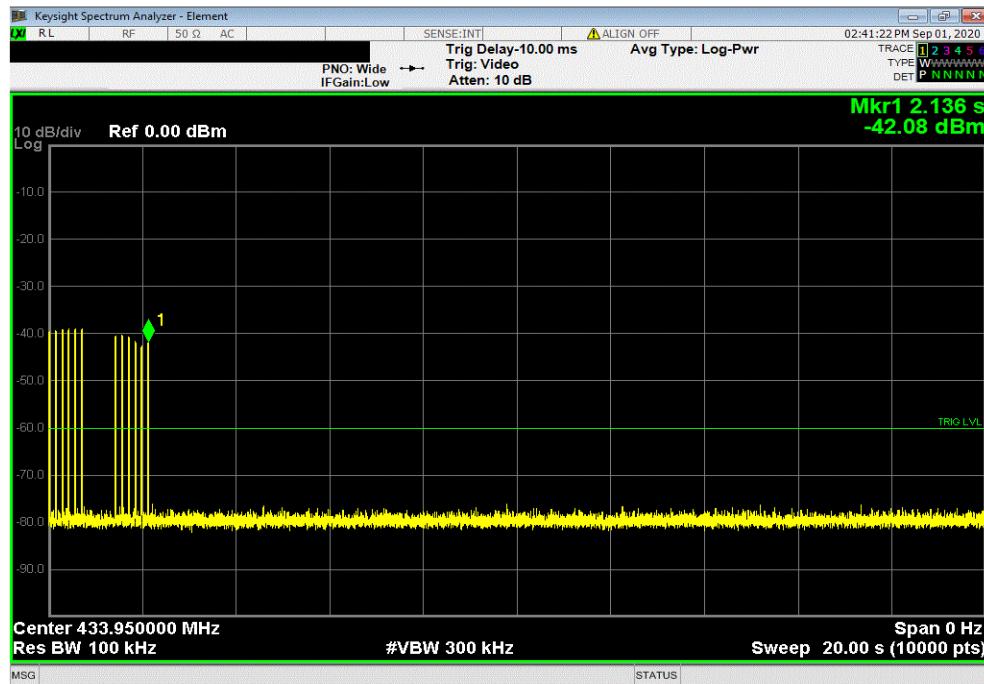
EUT:	RF-CHW-16-433-CLR		Work Order:	CINC0055		
Serial Number:	CM12C		Date:	1-Sep-20		
Customer:	CINCH Systems		Temperature:	22.1 °C		
Attendees:	Jibril Aga		Humidity:	49.8% RH		
Project:	None		Barometric Pres.:	1011 mbar		
Tested by:	Dustin Sparks	Power:	110VAC/60Hz		Job Site:	MN09
TEST SPECIFICATIONS			Test Method			
FCC 15.231:2020			ANSI C63.10:2013			
COMMENTS						
None						
DEVIATIONS FROM TEST STANDARD						
None						
Configuration #	4	Signature	<i>Dustin Sparks</i>			
			Type 1 Pulse Width (ms)	Type 1 Pulse Count	Type 2 Pulse Width (ms)	Type 2 Pulse Count
Sweep Time			N/A	N/A	N/A	N/A
20 s Sweep			N/A	N/A	N/A	N/A
2 s Sweep			N/A	N/A	N/A	N/A
100 ms Sweep			N/A	N/A	N/A	N/A
21 ms Sweep			0.6528	1	0.09387	55
					0.1856	20
						9.53

DUTY CYCLE

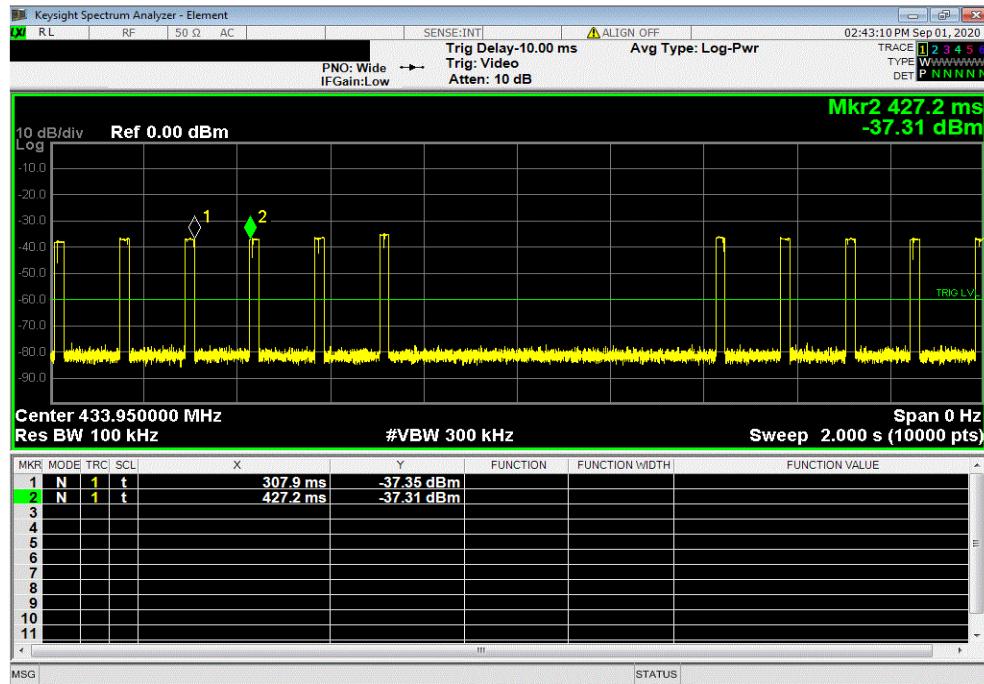


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Sweep Time, 20 s Sweep						
Type 1 Pulse Width (ms)	Type 1 Pulse Count	Type 2 Pulse Width (ms)	Type 2 Pulse Count	Type 3 Pulse Width (ms)	Type 3 Pulse Count	On Time (ms) in 100 ms
N/A	N/A	N/A	N/A	N/A	N/A	N/A



Sweep Time, 2 s Sweep						
Type 1 Pulse Width (ms)	Type 1 Pulse Count	Type 2 Pulse Width (ms)	Type 2 Pulse Count	Type 3 Pulse Width (ms)	Type 3 Pulse Count	On Time (ms) in 100 ms
N/A	N/A	N/A	N/A	N/A	N/A	N/A

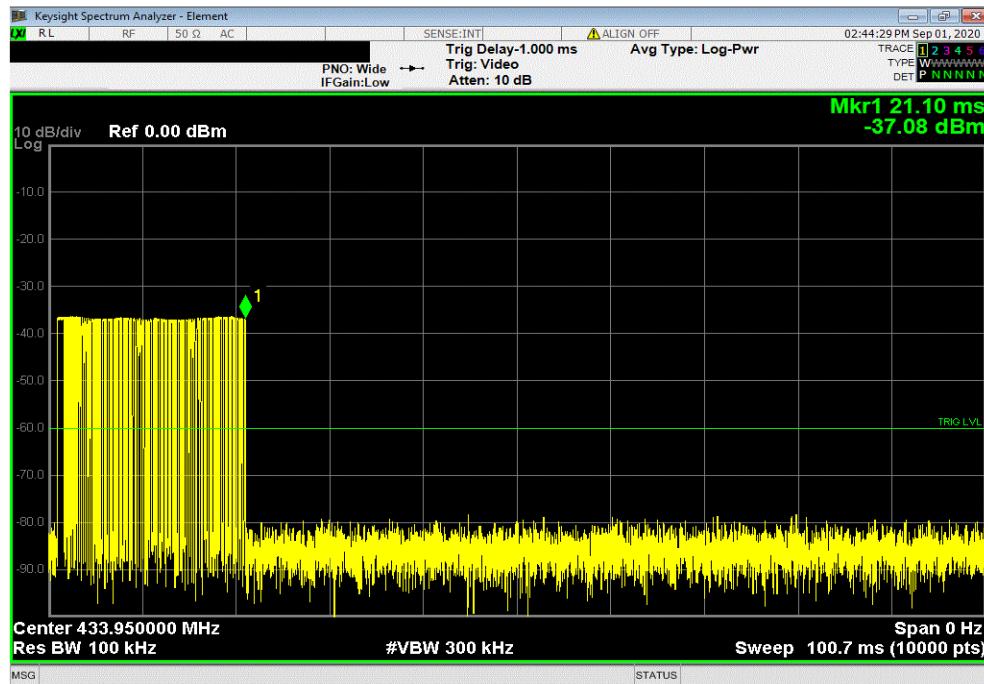


DUTY CYCLE



XMit 2020.03.25.0

Sweep Time, 100 ms Sweep						
Type 1 Pulse Width (ms)	Type 1 Pulse Count	Type 2 Pulse Width (ms)	Type 2 Pulse Count	Type 3 Pulse Width (ms)	Type 3 Pulse Count	On Time (ms) in 100 ms
N/A	N/A	N/A	N/A	N/A	N/A	N/A



Sweep Time, 21 ms Sweep						
Type 1 Pulse Width (ms)	Type 1 Pulse Count	Type 2 Pulse Width (ms)	Type 2 Pulse Count	Type 3 Pulse Width (ms)	Type 3 Pulse Count	On Time (ms) in 100 ms
0.6528	1	0.09387	55	0.1856	20	9.53

